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5-9-02

PATENT
Docket No. 361752000500

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of:

Keunsuk P. CHANG et al.

Serial No.: 09/715,013

Filing Date: Nov. 20, 2000

For: BIAXIALLY ORIENTED POLYPROPYLENE METALLIZED FILM FOR PACKAGING

Examiner: Kimberly T. Nguyen

Group Art Unit: 1774

DECLARATION OF KEUNSUK P. CHANG

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Keunsuk P. Chang declares under penalty of perjury under the laws of the United States of America as follows:

1. I am a citizen of the United States of America, residing at 31 Mayflower Ct., North Kingstown, RI 02852, USA. I am a co-inventor of the invention as described and claimed in the specification of this application. I received a Bachelor's degree in Chemical Engineering in 1983 from Princeton University and a Master's degree in Chemical Engineering from the University of Connecticut in 1985. After graduation, I worked at Mobil Chemical Company Films Division until 1995, working in various assignments in product development and manufacturing. In September 1996, I joined Toray Plastics (America), Inc. (a subsidiary of Toray Industries) and have been at Toray Plastics (America), Inc. in product development since. Currently I am Product Development Manager for the Torayfan division of Toray Plastics (America), Inc.

2. I have reviewed the Office Action of March 19, 2002, and am familiar with the invention and disclosure of U.S. Patent 5,698,317 (Kurokawa), whose inventor, Mr. Kurokawa, is a colleague here at Toray Plastics (America). Kurokawa's films are significantly lower in optical density than what has been disclosed and claimed in this application. Kurokawa's films are of nominal 2.2 optical density; this application's films are of nominal 2.8 optical density, with a minimum of 2.6 optical density, as shown in Table 1 below. "Chang Film" refers to the film of this application. As such, the barrier performance and barrier durability of the films disclosed in this application are significantly better as shown in the data disclosed by the patent application.

Table 1

Kurokawa Film OD	Chang Film OD
2.29	2.90
2.24	2.87
2.11	2.77
2.13	2.95
2.23	2.90
1.87	2.71
2.25	2.86
2.32	2.76
2.09	2.67
2.22	
2.15	
2.08	
2.32	
2.33	
2.30	
2.21	
2.44	
2.13	
ave = 2.206	ave = 2.821

3. I further present this Declaration to explain that the properties exhibited by this invention were not known or recognized prior to this invention. When Kurokawa developed his metallized films back in ca. 1995, the prevailing thought at the time was that higher optical density in metallized films had a negligible effect on improving moisture and oxygen barrier

= unexpected?

properties of laminate films, as a saturation point was thought to have been reached. Industry literature bears this out:

- 1997 Society of Vacuum Coaters 40th Conference Proceedings, "Barrier Degradation in Aluminum Metallized Polypropylene Films," by Yializis et al. This paper describes how oxygen and moisture barrier of metallized oriented polypropylene (OPP) films have an highest barrier property at 2.5 optical density and that above this value, barrier properties are actually *worse* due to cracking of the aluminum layer: "...metallized aluminum layers become more brittle as the thickness increases. This suggests that thinner [Al] films will produce better barriers" (p. 373-374, Figures 7 and 8).
- 1999 Society of Vacuum Coaters 42nd Conference Proceedings, "Properties of Metallized Film in a Free Span Web Metallizer," by Casey et al. This paper presented data that showed negligible improvement in moisture and oxygen barrier properties on metallized OPP films with optical density of 2.35 and 2.75. The paper cites that the 2.75 optical density film had "a marginal effect on barrier properties" compared to the 2.35 optical density film (p. 483).
- 1999 Society of Vacuum Coaters 42nd Conference Proceedings, "Permeation of Oxygen and Moisture through Vacuum Web Coated Films," by Moosheimer et al. This paper presented data showing that oxygen permeability through PET film metallized at various optical densities showed negligible improvement in oxygen barrier as aluminum thickness increased: "At an Al thickness of more than 60nm the O_2 barrier is improved only slightly by thickness" (p. 409 and p. 410, Figure 3).

The prevailing thought at the time of the present invention was that higher optical density aluminum metallized films (equivalent to aluminum thickness) had only a marginal effect in

improving barrier properties. In the present invention, however, significant improvements in barrier properties were found by using higher optical density deposition of aluminum on OPP film. In the data presented in the patent application, oxygen and moisture transmission properties (O_2TR and MVTR) of nominal 2.8-3.0 optical density were as much as *half* that of film metallized at nominal 2.3-2.5 optical density. See page 12 of the specification.

Moreover, the significant improvement in barrier durability after elongation or bag-forming was also unexpected prior to this invention. The prevailing thought in ca. 1995 was that higher optical density metallized films would actually be worse for barrier durability due to the metal layer being more prone to fracturing or cracking. Again, industry literature at the time bear this out:

- 1997 Society of Vacuum Coaters 40th Conference Proceedings, "Barrier Degradation in Aluminum Metallized Polypropylene Films," by Yializis et al. This paper presented data showing that aluminum layer cracking rate increases as a function of aluminum layer thickness and optical density. The authors write that "metallized aluminum layers become more brittle as the thickness increases. This suggests that thinner [Al] films will produce better barriers." (p. 373-374, Figure 7).
- 1998 Society of Vacuum Coaters 41st Conference Proceedings, "Metalization: An End-user's Perspective," by Specht, show data indicating a decrease in optical density after elongation of metallized OPP film laminations, presumably due to micro-cracks of the aluminum layer. Specht's data presented in Figure 11 of Specht shows that a nominally higher optical density film exhibits a greater loss of optical density that a lower optical density film (p. 444, Figure 11).
- 1998 Society of Vacuum Coaters 41st Conference Proceedings, "Durability of Thin PECVD SiOx Coatings on Polymer Films," by Leterrier et al. This

paper, although discussing vacuum deposited silicon oxide coatings on PET, presents data showing that thicker depositions of SiOx are intrinsically weaker and more prone to crack formation under stress than thinner SiOx layers: "...thinner [SiOx] coatings possess a higher strength [than thicker coatings] (p. 432). This reference shows that the prevailing thought at the time was that thicker depositions – including aluminum – are generally worse for fracture resistance when the film is stressed.

The examples in this application show that this is not the case. Thicker depositions – i.e. higher optical densities – of aluminum on OPP in accordance with this invention show the opposite effect whereby barrier properties are significantly improved when the film is stressed than lower optical density films. In fact, from the data presented in this patent application, after 9% elongation, the high optical density film shows a worsening of oxygen barrier of about 2.7 times compared to the lower optical density film, which shows a worsening of oxygen barrier of more than 6 times after 9% elongation.

4. The samples whose properties are shown in Table 1 and 2 of the patent application are those that I and Dr. R. Davé discussed with Examiners Nguyen and Kelly at the interview of April 16, 2002.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct. Executed at North Kingstown, RI, USA, this 30 day of April, 2002.

Keunsuk P. Chang